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09/755,071	01/08/2001	Kie Y. Ahn	M4065.0415/P415	5118

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[REDACTED] EXAMINER

ECKERT II, GEORGE C

[REDACTED] ART UNIT

[REDACTED] PAPER NUMBER

2815

DATE MAILED: 09/10/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	Application No. <b>09/755,071</b>	Applicant(s) <b>Ahn et al.</b>
	Examiner <b>George C. Eckert II</b>	Art Unit <b>2815</b>
<i>-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --</i>		
<b>Period for Reply</b> A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE <u>3</u> MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.		
- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication. - If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely. - If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication. - Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). - Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).		
<b>Status</b>		
1) <input checked="" type="checkbox"/> Responsive to communication(s) filed on <u>Aug 21, 2003</u>		
2a) <input type="checkbox"/> This action is FINAL.      2b) <input checked="" type="checkbox"/> This action is non-final.		
3) <input type="checkbox"/> Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under <i>Ex parte Quayle</i> , 1935 C.D. 11; 453 O.G. 213.		
<b>Disposition of Claims</b>		
4) <input checked="" type="checkbox"/> Claim(s) <u>19-28, 30, 31, 33-37, and 39-41</u> is/are pending in the application.		
4a) Of the above, claim(s) _____ is/are withdrawn from consideration.		
5) <input type="checkbox"/> Claim(s) _____ is/are allowed.		
6) <input checked="" type="checkbox"/> Claim(s) <u>19-28, 30, 31, 33-37, and 39-41</u> is/are rejected.		
7) <input type="checkbox"/> Claim(s) _____ is/are objected to.		
8) <input type="checkbox"/> Claims _____ are subject to restriction and/or election requirement.		
<b>Application Papers</b>		
9) <input type="checkbox"/> The specification is objected to by the Examiner.		
10) <input type="checkbox"/> The drawing(s) filed on _____ is/are a) <input type="checkbox"/> accepted or b) <input type="checkbox"/> objected to by the Examiner. Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).		
11) <input type="checkbox"/> The proposed drawing correction filed on _____ is: a) <input type="checkbox"/> approved b) <input type="checkbox"/> disapproved by the Examiner. If approved, corrected drawings are required in reply to this Office action.		
12) <input type="checkbox"/> The oath or declaration is objected to by the Examiner.		
<b>Priority under 35 U.S.C. §§ 119 and 120</b>		
13) <input type="checkbox"/> Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f). a) <input type="checkbox"/> All b) <input type="checkbox"/> Some* c) <input type="checkbox"/> None of: 1. <input type="checkbox"/> Certified copies of the priority documents have been received. 2. <input type="checkbox"/> Certified copies of the priority documents have been received in Application No. _____. 3. <input type="checkbox"/> Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).		
*See the attached detailed Office action for a list of the certified copies not received.		
14) <input type="checkbox"/> Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e). a) <input type="checkbox"/> The translation of the foreign language provisional application has been received.		
15) <input type="checkbox"/> Acknowledgement is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.		
<b>Attachment(s)</b>		
1) <input type="checkbox"/> Notice of References Cited (PTO-892)		
2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)		
3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s). _____		
4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____		
5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)		
6) <input type="checkbox"/> Other: _____		

Art Unit: 2815

## **DETAILED ACTION**

### *Response to Amendment*

1. Applicant's amendment dated August 21, 2003 in which claims 1-18 were canceled has been entered of record.

### *Claim Rejections - 35 U.S.C. § 102*

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless -

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) do not apply to the examination of this application as the application being examined was not (1) filed on or after November 29, 2000, or (2) voluntarily published under 35 U.S.C. 122(b). Therefore, this application is examined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

### *Claim Rejections - 35 U.S.C. § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 19, 21, 22, 24, 25, 28 and 30 are rejected under 35 U.S.C. 102(e) as anticipated by US 6,362,528 to Anand or, in the alternative, under 35 U.S.C. 103(a) as obvious over Anand in

Art Unit: 2815

view of Min et al. Anand teaches, with reference to figures 8-19, a dual damascene structure comprising:

a semiconductor substrate 11;

a first insulating layer 25 provided over the substrate;

a metal layer 17b provided within the first insulating layer;

at least another or second insulating layer 18 provided over the metal layer;

a via 19a situated within the second insulating layer 18 and extending to at least a portion of the metal layer, the via being lined with a titanium-silicon-nitride layer 20a and filled with a copper material 20b (col. 13, lines 11-13 and lines 17-18);

a third insulating layer 27 located over the second insulating layer;

a trench 19b situated within the third insulating layer and extending to the via, the trench being lined with the titanium-silicon-nitride and filled with copper (col. 13, lines 11-13, 17-18).

Regarding the limitation that the titanium-silicon-nitride layer which lines the via is formed by an organo-metallic-atomic deposited process, such limitation does not further define the structure as instantly claimed, nor serve to distinguish over Anand. Note that a "product by process" claim is directed to the product per se, no matter how actually made, In re Hirao, 190 USPQ 15 at 17 (footnote 3). See also In re Brown, 173 USPQ 685; In re Luck, 177 USPQ 523; In re Fessmann, 180 USPQ 324; In re Avery, 186 USPQ 161; In re Wertheim, 191 USPQ 90 (209 USPQ 554 does not deal with this issue); In re Marosi et al, 218 USPQ 289; and particularly In re Thorpe, 227 USPQ 964, all of which make it clear that it is the patentability of the final product

Art Unit: 2815

per se which must be determined in a “product by process” claim, and not the patentability of the process, and that an old or obvious product produced by a new method is not patentable as a product, whether claimed in “product by process” claims or not. Note that applicant has the burden of proof in such cases, as the above caselaw make clear.

In the alternative, if deposition of titanium-silicon-nitride by an organo-metallic process does result in a final product different in structure from the titanium-silicon-nitride layer taught by Anand, such process, and thus structure, is considered obvious. Specifically, Min et al. teach, in *Metal-organic atomic-layer deposition of titanium-silicon-nitride films*, the use of such organo-metallic deposition process. Anand and Min et al. are combinable because they are from the same field of endeavor. At the time of the invention it would have been obvious to a person of ordinary skill in the art to form the Ti-Si-N layer of Anand by the organo-metallic-atomic deposition process. The motivation for doing so, as is taught by Min et al., is that such process provides a Ti-Si-N film that prevents diffusion of Cu up to 800°C for about 60 minutes and provides step coverage of about 100% (Min et al., *Abstract*, last 2 sentences). Therefore, it would have been obvious to combine Anand with Min et al. to obtain the invention of claims 19, 21, 22, 24, 25, 28 and 30.

With regard to claims 21 and 22, Anand teaches that the another or second insulating layer 18 is formed of silicon dioxide and is 1  $\mu\text{m}$  or 10,000 Å thick (col. 12, lines 35-37). With regard to claims 24 and 25, Anand teaches that the third insulating layer 27 is formed of silicon dioxide and is 6,000 Å thick (col. 11, lines 41-42, lines 48-50, see also col. 11, lines 52-54). With regard

Art Unit: 2815

to claim 28, Anand teaches that the copper material is copper (col. 13, lines 17-18). With regard to claim 30, Anand teaches that the substrate is silicon (col. 11, line 32).

3. Claims 20, 23, 31, 33, 34, 37 and 39-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Anand and Min et al. in view of US 6,093,966 to Venkatraman et al. (of record). Anand and Min et al. teach or make obvious the device of claim 19 as discussed above, which also reads on limitations of claims 31 and 40, but does not teach that the insulating layers may be formed of polyimide. Venkatraman et al. teach that an insulating layer may be formed of silicon dioxide or polyimide (col. 4, lines 39-54). With regard to claim 40, Anand teaches that the integrated circuit which includes the dual damascene structure is formed as part of a ULSI (ultra large scale integrated circuit) which is considered a processor. Anand also teaches that the integrated circuit having the damascene layers is formed on the same chip as the processor (see generally figures 21-24).

Anand, Min et al. and Venkatraman et al. are combinable because they are from the same field of endeavor. At the time of the invention it would have been obvious to a person of ordinary skill in the art to use polyimide as the insulator of Anand. The motivation for doing so is that such a material has a low dielectric constant such that parasitic capacitance between conductors is reduced. Therefore, it would have been obvious to combine Anand and Min et al. with Venkatraman et al. to obtain the invention of claims 20, 23, 31, 33, 34, 37 and 39-41.

Art Unit: 2815

4. Claims 26 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Anand and Min et al. as applied to claims 19 and 31 above, and further in view of *Ti-Si-N Diffusion Barriers Between Silicon and Copper* to J. S. Reid et al. Anand and Min et al. teach or make obvious the device of claims 19 and 31 but did not teach that the Ti-Si-N liner layer is between 50 - 200 Å or specifically 100 Å thick. Reid et al. teach, on page 299 in the right hand column, first full paragraph, that a layer of Ti-Si-N may be formed at a thickness of 10 nm (100 Å).

Anand, Min et al. and Reid et al. are combinable because they are from the same field of endeavor. At the time of the invention it would have been obvious to a person of ordinary skill in the art to form the Ti-Si-N layer to a thickness of 100 Å. The motivation for doing so, as is taught by Reid et al., is that such thickness is sufficient to prevent copper migration up to a temperature of 650°C. Therefore, it would have been obvious to combine Reid et al. with Anand and Min et al. to obtain the invention of claims 26 and 27.

5. Claims 35 and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Anand and Min et al. in view of Venkatraman et al. and Reid et al. Anand, Min et al. and Venkatraman et al. made obvious the device of claim 31 as discussed above. However, they did not teach that the Ti-Si-N liner layer is between 50 - 200 Å or specifically 100 Å thick. Reid et al. teach that a layer of Ti-Si-N may be formed at a thickness of 10 nm (100 Å).

Anand, Min et al. and Venkatraman et al. are combinable with Reid et al. because they are from the same field of endeavor. At the time of the invention it would have been obvious to a

Art Unit: 2815

person of ordinary skill in the art to form the Ti-Si-N layer to a thickness of 100 Å. The motivation for doing so, as is taught by Reid et al., is that such thickness is sufficient to prevent copper migration up to a temperature of 650°C. Therefore, it would have been obvious to combine Reid et al. with Anand, Min et al. and Venkatraman et al. to obtain the invention of claims 35 and 36.

***Response to Arguments***

6. Applicant's arguments with respect to claims 19, 21, 22, 24, 25, 28 and 30 have been considered but are moot in view of the new ground of rejection.

***Conclusion***

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to George C. Eckert II whose telephone number is (703) 305-2752.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mr. Eddie Lee can be reached on (703) 308-1690. The fax phone number for this Group is (703) 308-7722.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956.

  
GEORGE ECKERT  
PRIMARY EXAMINER

GCE  
August 19, 2003